girls of the district, by means of pollen taken from different varieties. Fruits of various varieties and sizes, colour and flavour, resulted, resembling the sorts which had furnished the pollen.

As the ovary of plants perishes after the production of the fruit, and presents transitory connections with the plant itself, it is not probable that the somatic modifications produced by the pollen extend to the cells of the branch or of the stem. For the same reason these modifications cannot have a reaction on the subsequent products.

But with animals, and especially with the Mammalia, where the fœtus is for a long time in intimate connection with the mother, one may suppose that the action of the male element will have an influence on the maternal organism first, and later on the subsequent descendant.

"In the case often quoted from Lord Morton, a nearly purely-bred Arabian chestnut mare bore a hybrid to a quagga; she was subsequently sent to Sir Gore Ouseley, and produced two colts by a black Arabian horse. These colts were partially dun-coloured, and were striped on the legs more plainly than the real hybrid, or even than the quagga. One of the two colts had its neck and some other parts of its body plainly marked with stripes. Stripes on the body, not to mention those on the legs, are extremely rare . . . with horses of all kinds in Europe, and are almost unknown in the case of Arabians. But what makes the case still more striking is that in these colts the hair of the mane resembled that of the quagga, being short, stiff, and upright. Hence there can be no doubt that the quagga affected the character of the offspring subsequently begot by the black Arabian horse" (Darwin, *loc. cit.*, i. p. 435).

Turner, who recalls Darwin's example, found the assumption that attributes the presence of the stripes to a reversion towards an ancestor common to horse and quagga too complex and hypothetical. He believes that the mother, while she had the hybrid in her womb, acquired from it the faculty to transmit the characters of the quagga, owing to the necessary nutritive changes during the development of the fœtus. The germinative plasma of the mother, belonging to the ovules not yet ripe, will have been modified in the ovary itself; and this acquired variation will have its reaction on the later-born individuals of the same mother.

The same explanation has been admitted by other physiologists for similar facts often proved by breeders and by hunters, for different domestic animals, and especially for dogs. Indeed, one knows that when a bitch has been covered for the first time by a dog of another breed, its subsequent offspring will show one or more little peculiarities belonging to that other breed, although she has been covered afterwards by dogs of her own race.

The accuracy of this hypothesis will be strongly restricted if, as certain observers, such as Mr. Chapuis, affirm, the influence of the first male also shows itself in the case of birds (pigeons) where the relations between the mother and the little ones are much less intimate than among the Mammalia. But, however it be with this explanation, the fact itself, outside of all theory, sufficiently shows the close connection which exists among the reproductive and the somatic elements.

In order not to leave the domain of facts scientifically established, or hypotheses susceptible of a more or less easy proof, I shall set aside the influences which impressions produced on the senses and nervous system of the mother may have on the offspring. The popular belief in these influences is very ancient, for we read in Genesis that Jacob placed rods whose bark was marked in various ways before his father-in-law's sheep, in order to get certain markings on the lambs which the ewes bore. But the antiquity of a belief is not always a proof of its accuracy, and I admit with Weismann, that the cases quoted to prove the transmission of physical characters are not convincing, even in a case as curious as that of the mare of Baer.

Nevertheless, it seems to me very difficult to admit that the emotions and psychical impressions, which act so energetically and so evidently on all our secretions, have no influence on the products of the genital glands. Perhaps, outside the conditions of the surroundings and of education, which should be put in the first rank, one may attribute to an action of this sort the fact that all of one generation accept with the greatest ease the ideas which had been warmly combated and repelled by the preceding generation. It seems to me impossible that the intellectual movement caused by men of genius in one or more branches of human knowledge—a movement propagated and disseminated by men of letters and artists—has no reaction on the blastogenic elements of the contemporary generation, and consequently on the generation following, which thus will be prepared by hereditary transmission for an altogether new order of psychic modalities.

Finally, a last consideration leads us again to combat the opinion of those who maintain that acquired somatogenic characters cannot be transmitted from parents to infants. If, as already quoted from Turner, we push this theory to its final consequences, we are led to suppose that the ancestors of actual living beings, and the primordial protoplasm itself, possessed in themselves all the variations which have appeared since; and as, according to this hypothesis, the primary factors have acted only on the individual and not on the blastogenic elements (which alone can be transmitted), we must conclude that these possessed from the beginning, *i.e.* from the appearance of living matter, an evolutionary potency in a certain measure indefinite. We shall thus be led to the idea of creative forces, regulated, it is true, by selection. Thus again the door will be open to directing agents, immanent or outside of matter, and we shall require to renounce the grand mechanical conception of the universe, seen by Descartes, and followed up by the inquirers of the eighteenth century.

If, on the other hand, we admit the transmission of somatogenic characters in the measure proved by the facts cited above, the transformation of living beings will become much quicker, because it will not depend entirely on the chances of internal variation, but will be determined by the action of primary factors.

The *rôle* of selection and of secondary factors will remain most important, accelerating and regulating the transformation.

But before passing to the examination of secondary factors, we shall first study a biological phenomenon which we find whenever new organisms are produced—hereditary transmission. In explaining the production of these forms, whether we make use of the principle of Lamarck, the law of Delbœuf, or the selection of secondary factors, we have seen we always must admit the action of heredity.

Properly speaking, heredity is neither a primary nor a secondary factor. It is the integral, the sum of indefinitely small variations, produced on each anterior generation by the primary factors. The laws of heredity, hardly studied yet experimentally, offer a vast field for the sagacity of biologists. Several of these laws, and especially the law of homochronic heredity (*l'hérédité homochrone*), give good arguments for the principle of Lamarck. The most recent embryological researches begin to afford us a little insight into the mechanical process of hereditary transmission, and the deeper phenomena of reproduction.

It is only after carefully examining all the information acquired on these delicate matters that we can begin to study the secondary factors of evolution with profit.

THE INSTITUTION OF MECHANICAL ENGINEERS.

On Thursday and Friday of last week, the 29th and 30th ult., the forty-fourth annual general meeting of the Institution of Mechanical Engineers was held in the theatre of the Institution of Civil Engineers, the latter society extending their usual hospitality to the sister Institution.

There were but two papers on the agenda, viz.:—On some different forms of gas furnaces, by Mr. Bernard Dawson; and on the mechanical treatment of moulding sand, by Mr. Walter Bagshaw, of Batley.

The fourth report of the Research Committee on Friction, which deals with experiments on the friction of a pivot bearing, was also down for reading, but time did not permit of it being taken. This was chiefly due to the fact that Mr. Macfarlane Gray proposed an alteration in the bye-laws, in virtue of which any full member who had paid thirty annual subscriptions—£3 each—should become a life member without further payment. This proposal received influential support in the course of a long discussion, but was nevertheless negatived on a division by a considerable majority.

The President, Mr. Joseph Tomlinson, occupied the chair on both evenings.

Mr. Dawson's contribution was one of considerable interest,

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and gave rise to a long discussion. The paper was illustrated by a large number of wall diagrams which covered the whole side of the theatre. The author treated his subject in a comprehensive manner, going into the question historically, and dealing with gas furnaces of almost all kinds; many of the types described being indeed only interesting from a historical standpoint, as they had not proved valuable from an economic point of view. As Mr. Dawson said, however, one often learns as much from failures as from successes; and it is necessary at times to know what to avoid in order to know what to imitate.

From what we have said it will be evident that we cannot hope to follow the author into his description of the many types of gas furnaces he deals with, both from limitations of space, and also from lack of the pictorial aids he had called in, by means of the diagrams, in describing the arrangements of the furnaces. We must therefore confine ourselves to the broad features of the paper, and refer those of our readers who wish to follow up this most interesting subject to the Transactions of the Institution.

The author commenced by stating that the greater number of gas furnaces in which crude heating gas has been successfully applied, have been of the reversing regenerative type. There are many processes, however, requiring temperatures below that maintained by the use of regenerators, and in these gas furnaces have also been used with success. It is also often an advantage to be able to concentrate in one spot the manipulation of all the fuel required in scattered furnaces. For these reasons, amongst others, it is often desirable to employ gas fuel when the cost of saving in fuel may be a secondary consideration. The annealing of steel castings, heating plates and angle bars, &c., are cases in point. On the other hand, there are cases in which a higher temperature is required, such as cannot be attained by combustion of gas with cold air, and in these continuous regeneration—as opposed to reversing regeneration—may be applied; the regeneration having the effect of recovering the heat from the waste gases. In either case the escaping gases must retain sufficient heat to secure the necessary draught; in fact regeneration may be carried too far. The author gives a useful word of warning on this point, some designers being of opinion that they cannot have too much of the good thing, regeneration. There have been many failures due to a want of appreciation of this point.

The author divides gas furnaces into four classes: (*a*) with reversing regeneration; (*b*) with continuous regeneration; (*c*) non-regenerative; and (*d*) with blowpipe or forced blast.

Furnaces with reversing regeneration (Class *a*) are of several different kinds. (1) The ordinary Siemens furnace, the arrangement of which is well known. (2) The Batho or Hilton furnace, in which the regenerators are above ground. (3) Furnaces in which the air only is regenerated, the gas being admitted direct. (4) Furnaces in which a portion of the waste heat is taken back to the producer.[1] (5) The regenerative blast-furnace stoves of the Cooper and Whitwell types.

In furnaces with continuous regeneration (Class *b*), the air is heated in flues by radiation or conduction from the bottom of the furnace, and through thin walls which separate the air-flues from the flues that carry the spent gases to the chimney.

In non-regenerative furnaces (Class *c*), the air is admitted to the furnace at atmospheric temperature.

The blowpipe or forced blast furnaces (Class *d*) are of two kinds: firstly, those in which air is supplied at atmospheric temperature by a fan; and secondly, those in which the air is heated by the spent gases by being passed either through coils or stacks of pipes, or else through brick tubes or flues.

For reasons already stated, we cannot follow the author into the details of the various types here broadly sketched. The classification is, however, valuable, and supplies a standard which doubtless will be followed by others when dealing with this subject of daily growing importance.

Before closing our brief abstract of this paper, we will repeat a quotation the author makes from an address of the late Mr. Holley, delivered sixteen years ago, as it does justice to the foresight of that great American engineer and metallurgist, to whom not only his own countrymen, but European engineers also, owe so much. In his Presidential address to the American Institute of Mining Engineers, Mr. Holley said: "Regenerative furnaces will gradually but inevitably take the place of the ordinary heating, puddling, and melting furnaces, thus preventing the application of unspent furnace heat to steam generation." It should be remembered that in those days the generation of steam was looked on, in the general metallurgical trades, as the proper and legitimate means of recovering heat from waste furnace gases. How ill the device served this end those who know the difficulties and dangers of furnace gas fired boilers will recognize.

The discussion on this paper was opened by Mr. Aspinall, the Superintendent of Mechanical Engineering to the Lancashire and Yorkshire Railway, who bore testimony to the successful working of gas furnaces in engineering practice at the company's works at Horwich.

Mr. John Head, who is connected with Mr. Frederick Siemens, also spoke at some length, in the course of his speech dealing with the new Siemens furnace, and giving instances of its successful working.

Mr. Smith-Casson, of Lord Dudley's Round Oak Iron Works, also gave interesting particulars of a furnace he had designed and erected. This furnace has overhead regenerators, a type which is now attracting a good deal of attention. It is interesting to note that Mr. Smith-Casson does not advocate overhead regeneration in all circumstances. It is a subject, he said, upon which he has still an open mind. As another speaker pointed out, there is this objection to an elevated regenerator, that the heated air naturally rises to the highest point, and therefore the circulation may not be as efficient as in cases where the regenerators are placed below the hearth.

Mr. A. Slater described a device in an ordinary boiler furnace in which iron retorts are placed at the back of the furnace bridge, and in these steam is dissociated and returns to the furnace for combustion of the gases. As Mr. Macfarlane Gray pointed out, this appears nearly akin to the perpetual motion theories; but a useful effect may be obtained by transferring heat from a place where it is not wanted to a place where it is. Mr. Slater said the application of this device gave a saving of 38 per cent. of fuel burnt, which only proves that Mr. Slater's boilers must have been of extremely bad proportions originally.

A good deal of the discussion turned on the burning of gaseous fuel in steam-boilers. In connection with this subject we cannot do better than quote a remark made by Prof. Alexander Kennedy. As to the saving of burning gas with regenerative furnaces in metallurgical operations, there can be but little divergence of opinion; but in the case of generation of steam, quite a different set of conditions will arise. In steel-making, for instance, it is necessary that there should be intense local heat, and the gases must leave the furnace at an enormously high temperature. In boiler furnaces intense local heat is to be avoided, and the products of combustion pass to the chimney comparatively cool. Thus a steam-boiler may show an evaporative efficiency or fuel economy so high that little more heat is left in the spent gases than is necessary to supply chimney draught, and in such a case regenerators would be useless. In metallurgical operations the efficiency of the furnace would be something absurdly low without regenerators, perhaps not more than 5 per cent. We commend these remarks to those visionaries who think that so much better results can be obtained by complicated gas-generating devices in steam-boilers, than by burning coal simply logically on a grate.

The paper of Mr. Bagshaw was of a nature which confined its interest chiefly to practical founders, and does not require extended notice at our hands.

The summer meeting of the Institution will be held at Liverpool during the last four days of July.

SCIENTIFIC SERIALS.

THE *Quarterly Journal of Microscopical Science* for January contains:—Studies on the comparative anatomy of sponges, by Arthur Dendy, M.Sc.: (3) On the anatomy of *Grantia labyrinthica*, Carter, and the so-called family Teichonidæ (plates i. to iv.). In the introduction to this paper the author refers to the large collection of sponges made by Mr. Bracebridge Wilson in the neighbourhood of Melbourne, during the last few years, numbering about 2000 specimens. This series, as well as the collection in the National Museum at Melbourne which has been placed at his disposal by Sir F. McCoy, he hopes to name and describe in time; but as such a work must extend over some years, he purposes from time to time to note new or important

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[1] This is the new Siemens furnace which was fully described in a paper read before the Iron and Steel Institute, by Mr. John Head, in 1889.

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